PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Association between mental health and executive dysfunction and the moderating effect of urban-rural subpopulation in general adolescents from Shangrao, China, a population-based cross-sectional study
AUTHORS	Lin, Qingmin; Abbey, Cody; Zhang, Yunting; Wang, Guanghai; Lu, Jinkui; Dill, Sarah-Eve; Jiang, Qi; Singh, M.K.; She, Xinshu; Wang, Huan; Rozelle, Scott; Jiang, Fan

VERSION 1 – REVIEW

REVIEWER	Wang, Zhengyan Capital Normal University, School of Psychology
REVIEW RETURNED	26-Feb-2022

GENERAL COMMENTS	This study aimed at investigating the moderating effect of home residence and school location on the association between mental health symptom and executive function among general adolescents. The results have shown that mental health symptoms were common in the samples, and their prevalence rates in the RR (adolescents who have rural hukou and attend rural schools) and RU (adolescents who have rural hukou and attend urban schools) subgroups were significantly higher than those in the UU (adolescents who have urban hukou and attend urban schools) subgroup, mainly due to having more screen time. Furthermore, this study found that there were marginal interactive effects of urban-rural subgroup with depression and anxiety on EDF, specifically the UU adolescents with depression and anxiety issues had a much higher EDF risk than their RR peers. This study highlighted the importance of moderating effect of urban-rural subpopulation and done some work for better understanding association between mental health symptoms and executive dysfunction in general adolescent. I have several suggestions in hopes of improving this manuscript: 1. I think the most important part of this study that should be improved is the purpose of the study in the abstract. As you said in the paper, to examine the association between mental health and executive function in general adolescents. But in the most parts of the paper, executive dysfunction was used and analyzed. So, I think the purpose of the study in the abstract is to examine the association between mental health and executive dysfunction in general adolescents. 2. The theoretical derivation part of this study is rather weak and the theoretical basis is not very adequate. For example, the introduction section has few introductions about the association between mental health and EDF. As you said in the introduction, mental health illnesses can increase the risk of EDF, you should

	give more examples of how different kinds of mental health illnesses affect EDF. 3. In the methods, a multi-stage cluster random sampling method was used in this study. The number of UU is 292, which is much less than RU (n = 819) and RR (n=784) subpopulations, what is the reason for this, it is not clear to me. As you write in the participants, four schools stratified by rural and urban areas were randomly chosen from each district/country. I think the number of the three subpopulations was similar, but I didn't expect the number was different, which might lead to a different result than expected. Hukou as a variable is mixed. The core behind the hukou reflects the socioeconomic status of the family and It is recommended to identify whether SES would moderate the association between mental health and executive function in general adolescents. In the UU (adolescents who have urban hukou and attend urban schools) subgroup, the number of parents whose education level is Lower than high school is 118 (41.0) and the number of family which Gross family income (RMB) is Lower than 50,000 is 95 (38.6). 4. In the measurement of executive dysfunction, the Behavior Rating Inventory of Executive Function (BRIEF) was used to capture an individual's everyday behavioral and emotional aspects of EF. In this study, parent report form with 86 items was uesd to rate adolescents' specific behaviors. BRIEF also has a self-report form for adolescents and a teacher report form. Moreover, adolescents spend most of their time at school, and parents are not always with them, so what was the reason for choosing the parent report form and how to ensure the accuracy and objectivity of the scoring? 5. In the covariates, sociodemographic information including parental education level and gross family income, as well as the adolescent's age, sex, and chronic disease history. We know that parenting and caregiving differ greatly across family types, rural or urban. I would like to know how to control the effect of these above covariates? 6. In the part of results, mental health symptoms were higher in the RR and RU subgroups than in the UU subgroup. However, there has been a debate about the differences in mental health symptoms between urban and rural children and adolescents. Based on the results of different studies, the authors could be reanalyze and discuss them. 7. In the part of discussion, the reasons why adolescents in RR and RU have worse mental health symptoms than those in UU are discussed. However, the explanation of the reason for the result is not clear enough to me, and I hope the author will explain in more detail. Besides certain sociodemographic and lifestyle behaviors in this paper, are there any other variables that should be discussed? Furthermore, the authors could make more practical suggestions for improving the mental health of rural adolescents. These are all my suggestions. Thank you for your hard work on this manuscript. It is clearly written, and I wish you the very best in your endeavors.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Dr. Zhengyan Wang, Capital Normal University

Comments to the Author:

This study aimed at investigating the moderating effect of home residence and school location on the association between mental health symptom and executive function among general adolescents. The results have shown that mental health symptoms were common in the samples, and their prevalence rates in the RR (adolescents who have rural hukou and attend rural schools) and RU (adolescents who have rural hukou and attend urban schools) subgroups were significantly higher than those in the UU (adolescents who have urban hukou and attend urban schools) subgroup, mainly due to having more screen time. Furthermore, this study found that there were marginal interactive effects of urban-rural subgroup with depression and anxiety on EDF, specifically the UU adolescents with depression and anxiety issues had a much higher EDF risk than their RR peers. This study highlighted the importance of moderating effect of urban-rural subpopulation and done some work for better understanding association between mental health symptoms and executive dysfunction in general adolescent. I have several suggestions in hopes of improving this manuscript:

1. I think the most important part of this study that should be improved is the purpose of the study in the abstract. As you said in the paper, to examine the association between mental health and executive function in general adolescents. But in the most parts of the paper, executive dysfunction was used and analyzed. So, I think the purpose of the study in the abstract is to examine the association between mental health and executive dysfunction in general adolescents.

Authors responses:

Thank you for your insightful suggestion, and we have revised this point accordingly.

2. The theoretical derivation part of this study is rather weak and the theoretical basis is not very adequate. For example, the introduction section has few introductions about the association between mental health and EDF. As you said in the introduction, mental health illnesses can increase the risk of EDF, you should give more examples of how different kinds of mental health illnesses affect EDF.

Authors responses:

Thank you for the comment. Our study was aimed to examine the association between mental health and EDF in general adolescents, and to identify whether home residence and school location would moderate that association using a population-based cross-sectional survey. Considering of the human, physical and financial resources, we did not collect biological sample, such as blood. So, we could not determine the question "how different kinds of mental health illnesses affect EDF in general adolescents", which is also not our aims in the present study.

However, we agree with you that "giving more examples of how different kinds of mental health illnesses affect EDF" is an important information, which will help us understanding the association between mental health illnesses and EDF more deeply. Therefore, we provided this information in the fourth paragraph of the discussion part: "Across all three subgroups in our sample, mental health symptoms were consistently associated with EDF. That is, poor mental health associated with EF impairment even among general adolescents, supporting one recent study with nonclinical-based samples.[10] Studies from clinical patients indicated that the potential mechanism may be attributed to the dysregulation of the hypothalamic–pituitary axis with hyper activity[37] and neural-immune crosstalk with elevated cytokine production[38]. When these occurred in the central nervous system, brain architecture, morphology, and functional activity may be altered, thereby reducing an adolescent's

EF.[2 39] More studies on the mechanisms behind the association between mental health and EF in general adolescents should be conducted in the future.".

3. In the methods, a multi-stage cluster random sampling method was used in this study. The number of UU is 292, which is much less than RU (n = 819) and RR (n=784) subpopulations, what is the reason for this, it is not clear to me. As you write in the participants, four schools stratified by rural and urban areas were randomly chosen from each district/country. I think the number of the three subpopulations was similar, but I didn't expect the number was different, which might lead to a different result than expected. Hukou as a variable is mixed. The core behind the hukou reflects the socioeconomic status of the family and It is recommended to identify whether SES would moderate the association between mental health and executive function in general adolescents. In the UU (adolescents who have urban hukou and attend urban schools) subgroup, the number of parents whose education level is Lower than high school is 118 (41.0) and the number of family which Gross family income (RMB) is Lower than 50,000 is 95 (38.6).

Authors responses:

Thank you for your insightful comment. We have rechecked the data, and it is correct that the number of UU (n = 292) is much less than RU (n = 819) and RR (n=784) subpopulations. The main reason is that Shangrao is a relatively socioeconomically underdeveloped city in southeast China, and the most selected adolescents (84.6%) were rural origin, which is more than the average of the total population in China (70%).

Our study was pay attention to the hukou, a social issue, on adolescent mental health and executive function. Because, hukou established officially in 1958 classifies each Chinese citizen as either urban or rural origin according to his/her permanent residential area, which would led to unequal accessibility to governmental resources between rural and urban residents, including education, healthcare and retirement pension etc. The residents in rural areas usually had less access to employment, education and healthcare resources. Despite the relaxation of this household registration policy over decades, the overall situation was still not favorable for the migrants relocating their families to urban area.

We agree with you that hukou as a variable is mixed, and is significantly associated with the socioeconomic status of the family. Considering of the above-mentioned concerns, we examined the prevalence rates of the three mental health problems, and the association between mental health and executive dysfunction across the urban-rural subpopulations with before and after adjusting the income and education, as well as other covariates. Our result indeed found that "the prevalence of mental health symptoms was significantly higher among rural origin adolescents when compared to their urban peers, and such disparities were primarily explained by excessive screen exposure. Adolescents with mental health symptoms were more likely to have EDF regardless of urban-rural, and urban adolescents with depression and anxiety had a much higher EDF risk than their rural peers."

4. In the measurement of executive dysfunction, the Behavior Rating Inventory of Executive Function (BRIEF) was used to capture an individual's everyday behavioral and emotional aspects of EF. In this study, parent report form with 86 items was uesd to rate adolescents' specific behaviors. BRIEF also has a self-report form for adolescents and a teacher report form. Moreover, adolescents spend most of their time at school, and parents are not always with them, so what was the reason for choosing the parent report form and how to ensure the accuracy and objectivity of the scoring?

Authors responses:

Thank you for this comment. We agree with your concern. However, although there are three BRIEF forms to rate adolescents' specific behaviors, only the parent and teacher form have been

validated in Chinese population. Though the adolescents spend most of their time at school, both teacher and parent form were demonstrated that they have similar test-retest reliability coefficients (teacher form: 0.65-0.86, and parent form: 0.68-0.89) and Cronbach α coefficients (teacher form: 0.73-0.98, and parent form: 0.74-0.96). Moreover, significant moderate to high correlations (0.42-0.75, p<0.01) were found among subscales of BRIEF parent and teacher form. So, using the parent form can ensure the accuracy of the scoring.

Moreover, our study design was multi-stage cluster random sampling, i.e., districts/counties - schools - classes, and finally all students in the selected classes were invited to participate in our survey. Using the teacher report form means one teacher would rate all students in his or her class, which will add a lot of work to the teacher, and also increase rate errors. Therefore, the parent form will be more appropriate than the teacher form in our study.

Finally, given the subjective nature of the BRIEF questionnaire, we cannot ensure the objectivity of the scoring.

Reference:

Qian Y, Wang YF. [Reliability and validity of behavior rating scale of executive function parent form for school age children in China]. Beijing Da Xue Xue Bao Yi Xue Ban. 2007;39(3):277-283.

Qian Y, Wang YF. [Reliability and Validity of the Behavior Rating Inventory of Executive Function Teacher Form for School Age Children in China]. CHINESE MENTAL HEALTH JOURNAL. 2009;23(10):742-747.

5. In the covariates, sociodemographic information including parental education level and gross family income, as well as the adolescent's age, sex, and chronic disease history. We know that parenting and caregiving differ greatly across family types, rural or urban. I would like to know how to control the effect of these above covariates?

Authors responses:

Thank you for your insightful comment. We agree with you that the parenting and caregiving could influence the association between mental health and executive dysfunction. However, it is regrettable that we did not collect this information, and we have listed this as one of the limitation: "Fourthly, we did not collect the parenting and caregiving style which might influence the association between mental health and executive dysfunction.".

6. In the part of results, mental health symptoms were higher in the RR and RU subgroups than in the UU subgroup. However, there has been a debate about the differences in mental health symptoms between urban and rural children and adolescents. Based on the results of different studies, the authors could be reanalyze and discuss them.

Authors responses:

Thank you for this comment. We have checked and reanalyzed by the second co-author, and the result was correct. We have discussed this in the third paragraph of the discussion part.

7. In the part of discussion, the reasons why adolescents in RR and RU have worse mental health symptoms than those in UU are discussed. However, the explanation of the reason for the result is not clear enough to me, and I hope the author will explain in more detail. Besides certain

sociodemographic and lifestyle behaviors in this paper, are there any other variables that should be discussed? Furthermore, the authors could make more practical suggestions for improving the mental health of rural adolescents.

Authors responses:

Thank you for the comment.

For the reasons why adolescents in RR and RU have worse mental health symptoms than those in UU, we have discussed lifestyle behaviors (media exposure time) and sociodemographic factors (parental education and family income). We have revised some sentences: "Certain behavioral and sociodemographic differences between the urban-rural subgroups explained most of the disparities, which corresponded with the results of a previous study.[34] For example, our study indicated that the significant urban-rural differences of adolescent mental health problems were mainly attributed to screen time, which previous researches have linked it to less face-to-face communication with peers and families, less outdoor physical activity, and receiving plenty of potentially inappropriate information.[35] Another possible reason for these differences may be that the lower parental education levels and family income among rural adolescents lead to less mental health support.[36]".

For other potential influencing factors, just as your said in the fourth comment, the parenting and caregiving style could be one of the reasons. However, it is regrettable that we did not collect this information, and we have listed this as one of the limitation, see response to the fifth comment.

Furthermore, we have added some more practical suggestions for improving the mental health of rural adolescents: "On all accounts, the large share of rural adolescents experiencing more mental health problems is concerning and should receive more attention from policymakers in future adolescent health actions, such as establishing adolescent mental health and hygiene infirmary, and strengthening the publicity and education of the adolescent mental health knowledge in school and community, as well as mobilizing adolescents' enthusiasm of participating in outdoor activities to reduce their media exposure time, because the government policies have the potential to change many of these determinants.".

These are all my suggestions. Thank you for your hard work on this manuscript. It is clearly written, and I wish you the very best in your endeavors.

Authors responses:

Thank you so much for all your suggestions, which are very helpful. And we have already revised our paper based on your suggestions and responded to your concerns one by one. We hope we have done so satisfactorily.